Oxygen-Enrichment Studies of Alternative Fuel Vehicles

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Objective

To examine the potential merits of enriching combustion air with oxygen to reduce carbon monoxide (CO), hydrocarbons (HCs), air toxics, and aldehyde emissions, particularly during the first 30–60 seconds of the cold start in a flexible fuel vehicle (FFV) using indolene and M85 (85% methanol [MeOH], 15% gasoline) as fuels.

Oxygen enriched air supplied to the test vehicle

Approach

Argonne is using an FFV to obtain the emissions data at 21%, 23%, and 25% oxygen levels in the combustion air using indolene and M85 as fuels. Emissions data are collected by following the Federal Test Procedures (FTP) cycle and by employing the Environmental Protection Agency's (EPA's) recommended "off-cycle" test (EPA-REP05). Data collected include mass emissions, complete HC speciation, and second-by-second concentrations of HC, CO, and oxides of nitrogen (NO_x) in the exhaust. Engine-out and vehicle-out (catalytic converter-out) emissions data are being collected.

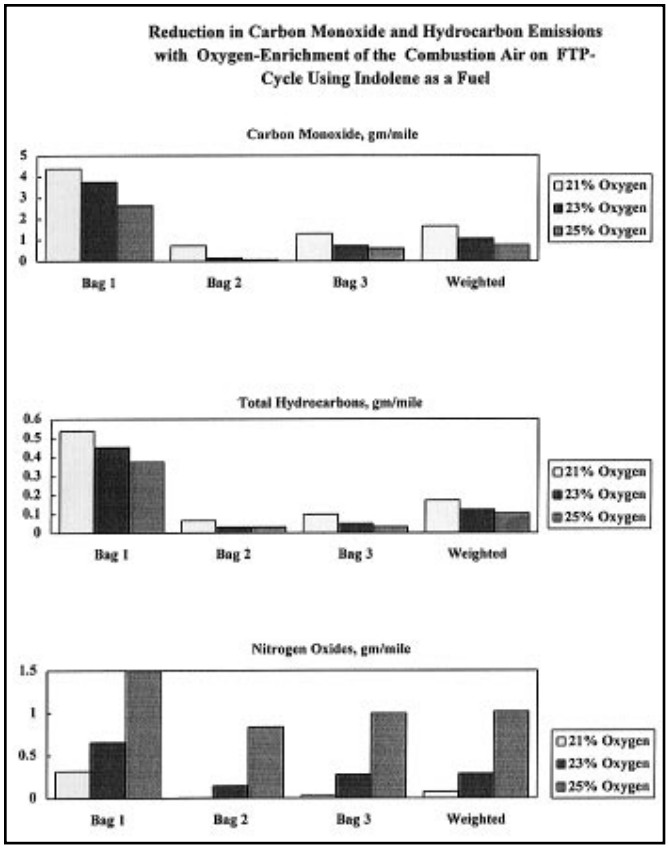
Accomplishments

We completed the baseline tests with indolene using FTP-cycle and off-cycle modes on a Dodge Spirit FFV. Three inlet oxygen levels (21%, 23%, and 25%) were used in the test matrix. The mass emissions, HC speciation, and time resolved emissions of the above tests are being analyzed. The test results indicate that CO, HC, and air toxic emissions were considerably reduced, especially during the cold-phase (bag 1) of the FTP cycle at 23% and 25% oxygen-enrichment levels with indolene as a fuel. Time-resolved emissions data indicate that during the first 25 seconds of the cold-phase, CO and HC emissions are reduced with no increase in NO_x emissions with 23% or 25% oxygen enrichment. Engine-out

emissions data are being collected to analyze the effects of enriched oxygen on the engine-combustion process in reducing the cold-phase emissions. FTP and off-cycle exhaust emissions from engine powered by M85 at 21%, 23%, and 25% oxygen levels will be measured during the following months.

Future Direction

- Design and procure an oxygen-membrane device for the FFV
- Conduct vehicle tests with oxygen-membrane device as an integrated system
- Evaluate the use of oxygen-enrichment technology for other alternative fuels.



Publications

Ng, H.K., R.R. Sekar, S.W. Kraft, and K.R. Stamper. 1993. *The Potential Benefits of Intake Air Oxygen Enrichment in Spark Ignition Engine Powered Vehicle.* SAE 932803.

Sekar, R.R., R.B. Poola, and H.K. Ng. 1994. "Oxygen-Enrichment in Spark-Ignition Engines." Paper Presented at the 1994 Annual Automotive Technology Development Contractors Coordination Meeting, Dearborn, MI, October 24–27.